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Original Article

Physical activity as a complementary approach for the pharmacological treatment of Fibromyalgia Syndrome: Effects of a 6-week aquatic strength and core training program.

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Abstract:
Fibromyalgia is a chronic and multifactorial disease, characterized by the presence of generalized pain that negatively influences the health-related quality of life of the affected person. Despite the severity and disabling effects that this disease causes in most cases, the physical and psychological symptoms can be alleviated through adequate physical fitness, with water-based exercise being one of the most recommended approaches for fibromyalgia patients. The objective of this case report was to verify the suitability and feasibility of a multicomponent aquatic training program carried out in a high temperature spa pool for a woman with fibromyalgia. For this purpose, a complete physical and psychological analysis in this patient with a history of lack of compliance and tolerance of physical activity is presented as a case report. A 62 year-old woman with fibromyalgia participated in 6-week program of strength, core, aerobic, and flexibility training developed in the aquatic environment, with analyses performed before and after intervention, where physical and psychological parameters were evaluated. The percentage of improvement showed an enhancement in all physical and psychological factors, with some test results over the reference values of minimal detectable change and minimal clinically significant difference for fibromyalgia patients and women of similar age. The presented case report provides a comprehensive examination of the physical and psychological status of a woman with fibromyalgia, prior to and proceeding a non-pharmacological intervention based on a multicomponent water-based training program. Results highlighted that a 6-week programme of water-based exercise program in a spa pool was suitable for reaching an enhancement in different physical and psychological parameters in this fibromyalgia patient, with her history of poor compliance and tolerance to conventional physical activity. If future studies with more sample size confirm our results, this approach could result interesting for fibromyalgia patients with low adherence and tolerance to land based training.

Key Words*:* **fmulticomponent training, aquatic exercise, quality of life, women health.**

Introduction

Fibromyalgia, included in 1992 in the International Classification of Diseases (Galvez-Sánchez & Reyes del Paso, 2020), is characterized as a chronic disease with a variable and individual evolution (Chicharro & Mojares, 2008) and a higher prevalence among women (Marques et al., 2017). Among the main fibromyalgia symptoms or related involved problems can be distinguished a generalized pain (with tender points) (Galvez-Sánchez & Reyes del Paso, 2020; Wolfe et al., 2010) fatigue, insomnia, muscle stiffness (Sañudo et al., 2010), irritable bowel syndrome (Chicharro & Mojares, 2008), cognitive problems, depressive states (Pedro Ángel et al., 2012) and bone diseases (as osteopenia) (Lee & Song, 2017) among others. All of this symptomatology and related problems are accentuated when occurring stressful situations or due to a sedentary lifestyle (Gavilán-Carrera et al., 2020).

The multifactorial nature of the disease conditions causes that the person have to undergo a treatment targeting different strategies (both pharmacological and non-pharmacological approaches), treating with different professionals, experts in rheumatology, psychology, physiotherapy and physical exercise (D'Arcy et al., 2016; Maffei, 2020). In recent years, the non-pharmacological therapies have played an important role within the treatment of fibromyalgia symptomatology (Kia & Choy, 2017; Schmidt-Wilcke & Diers, 2017). In fact, it seems that this type of non-pharmacological strategies could produce better outcomes for the population with fibromyalgia, possibly due to the relationship between the physical and psychological state of the patients and their related-to-health quality of life (Sempere-Rubio et al., 2019).

In this sense, therapies based on physical exercise are presented as important and fundamental strategies aiming to improve the fibromyalgia symptoms in the short term (Ramel et al., 2009). In fact, different previous

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studies affirm that aerobic, strength and multi-component exercise produces improvements in well-being, functionality and pain reduction on the fibromyalgia patient (Busch et al., 2013). Within these therapies based on physical exercise, the aquatic training approach has gained importance in recent years. In fact, recent studies show the benefits of this type of training on older adults with different pathologies such as type 2 diabetes and hypertension (Machado et al., 2020; Silva et al., 2021). In the same way, aquatic training seems to be an ideal complementary treatment for people with fibromyalgia, due to its properties (buoyancy, temperature and viscosity) (Fuentes & Santos, 2002) and because this type of exercise (based on strength, proprioception, balance and aerobic training) allows to partially eliminate the action of gravity and its impact on the osteoarticular structures (Assis et al., 2006).

Interestingly, training in the aquatic environment at high temperatures, preferably between 33ºC and 36ºC (Bidonde et al., 2014), allows significant reductions in the pain levels of the patients (Segura-Jiménez et al., 2013), as well as improvements into the symptomatology, cardiorespiratory system, functionality, strength, pain, depression and anxiety (Bidonde et al., 2014). Additionally, the aquatic training approach has shown improvements very similar to those caused in the land environment, and even greater in psychological and emotional aspects (Assis et al., 2006) and equivalences regarding the improvement of the balance in these patients (Neira et al., 2017). In summary, aquatic training appears to produce beneficial effects on both the physical and physiological health of people with fibromyalgia (Britto et al., 2020).

Despite the multiple benefits and possibilities that offers the physical fitness performed in the aquatic environment at high temperatures, to the best our knowledge, this is the first case report that analyzed accurately the suitability of a multicomponent aquatic training program for a woman with fibromyalgia syndrome, including a complete analysis of both physical and psychological parameters. This training program has been proposed for this person as a new approach due to its lack of adherence and low tolerance to other types of non-pharmacological therapies, as the conventional land-based physical practice. From this standpoint, we justify the need for this investigation, which aims to demonstrate the suitability that a multicomponent aquatic training at high temperatures can report to a patient with fibromyalgia with low adherence and tolerance to land-based training. Additionally, this study aimed to know the benefits of this aquatic training approach in this patient, performing a comprehensive analysis on different physical and psychological parameters related to fibromyalgia syndrome.

Material & methods

Patient information

The study participant is a 62-year-old woman, retired, with a low level of daily physical activity and sedentary profile. After 2 years of pain, she was diagnosed with fibromyalgia at 57 of age. At the moment of the commencement of this study, she was suffering exacerbations of symptoms, both physical and psychological, that affected her day-to-day life. In addition, she had started to experience bone problems (osteopenia). Regarding her pharmacological treatment, the participant was only treated for osteopenia, with sporadic consumption of anti-inflammatory and anti-depressants drugs for fibromyalgia. Regarding non-pharmacological treatments, at first the patient only took low intensity walks once or twice per week, but unfortunately, adherence to physical practice was not achieved, so it was not possible to advance towards greater complexity in the sessions. Given the presence of physical and psychological fibromyalgia symptoms and osteopenia related problems in the patient, it was decided to start an aquatic-based training in a conventional pool. In this second intervention, despite reaching a greater adherence level, an exacerbation of symptomatology and a worse tolerance to physical activity practice was observed in the patient, possibly due to the low temperature of the water and the environment of the pool. For this reason, it was finally decided for the present intervention to maintain the aquatic training but now performed in a more conducive environment. In this sense, the aquatic facilities of a Spa present the ideal characteristics for this training approach through the functional aquatic program for this woman with fibromyalgia. The specific characteristics of the program are detailed below, in Table 3. Prior to her participation, the patient was informed of the objectives and purposes of the study, as well as all the instruments and protocols used. Once informed, she gave her consent and voluntary signature to participate in the program and to take part in this case report as participant.

Diagnostic assessment

This article adheres to the CARE (Case Report) guidelines (Gagnier et al., 2014; Riley et al., 2017). For evaluating all the selected components related to the representative physical and psychological symptoms of a patient with fibromyalgia, a quantitative case report with two data collection moments, pre and post intervention, was designed. Anthropometric data and physical fitness (strength, balance, agility and aerobic) were evaluated using specific instruments and tests. Subjective perception of health and fatigue, pain index, quality of sleep, depression, interference of symptoms of activities of daily living was determined by specific questionnaires. Table 1 shows in detail the different parameters analyzed, and the instruments used.

Table 1. Tests and evaluation instruments.

Test	Instruments and tests
Anthropometry	
Height	Stadiometer (Soehnle® 5003, China)
Weight	Seca®869 Scale (Seca Gmbh & Co®, Hamburg, Germany)
Physical test	
Hand Grip Strength (kg)	Takei® dynamometer (T.K.K.5401, Japan). Accuracy of ± 2 kg[1]
Lower limb strength (s)	30 seconds chair stand (30 s. Chair stand)[2]
Static balance	The Short Physical Performance Battery
Agility (s)	Timed Up and Go (TUG)[2]
Aerobic capacity and endurance (m)	6 minutes walking test (6MWT)

Kg: kilograms; s:seconds; m:meters. [1](Aparicio et al., 2015); [2](Millor et al., 2013; Rikli & Jones, 2013)

Table 2 describes the health-related questionnaires used. All if these parameters were measured pre- and post- intervention, performing all the psychological tests firstly, and all the physical tests secondly, to avoid possible interferences in the results.

Table 2. Tests and evaluation questionaries.

Test	Questionnaire	Score
Quality of life related to health		
Subjective perception of health	Spanish version of SF-36 (SF-36)[1]	0 to 100, being 100 the best score
Pain/Interference Index in DLA	Brief Pain Inventory (BPI)[2]	0 to 10, being 0 absence of pain in DLA.
Amount of pain (mm)	Visual Analogue Scale (VAS)[3]	0 to 100 mm, being100 very severe pain.
Sleep quality	Pittsburgh Sleep Quality Index (PSQI).	0 to 25, lack of quality of sleep from 5.
Fatigue index	Multidimensional Fatigue Inventory (MFI-20)[4]	20 items with no established reference values*
Depression	Beck's Depression Inventory (BDI)[5]	0 to 63. Score >40 extreme depression.
Fibromyalgia Impact on DLA	Revised Fibromyalgia Impact Questionnaire (FIQR)[6]	0 (low incidence) to 100 (high incidence).

DLA: daily life activities; mm: millimeters; *MFI-20: composed of 20 items into 5 dimensions (general fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation), The improvement in each item is valued. [1](Vilagut et al., 2005); [2](Cleeland & Ryan, 1994); [3](Gould et al., 2001); [4](Smets et al., 1995); [5](Richter et al., 1998); [6](Bennett et al., 2009)

Therapeutic Intervention

Previous experience of exercising in the water with this patient had already showed good levels of adherence to exercise. However, the properties of a conventional pool were not the most suitable for the treatment of fibromyalgia symptoms. Consequently, we decided to start a multicomponent and totally aquatic functional fitness program in the facilities provided by a spa with higher water and room temperatures. Table 3 shows a detailed description about the progression and main components of the multicomponent aquatic functional training program. With a duration of 6 weeks and a total of 17 sessions (2 sessions for the first week and 3 for the remaining 5 weeks), this fitness program was planned and designed following the 11 recommendations of the American College of Sports Medicine for improvement of the health and the quality of life in people with fibromyalgia (ACSM, 2013), as well as previous intervention studies in the aquatic environment for this population (Assis et al., 2006). This program is also supported and based on previous experimental works and methodological considerations targeting elderly population (Tomas-Carus et al., 2008; Tortosa-Martínez et al., 2018).

Table 3. Scheme about the description and progression of the multicomponent aquatic functional training program

6-Week Multicomponent Aquatic Fitness Program				
Warm-up				
Aquatic Walking (changing directions) Aquatic Slow Run Aquatic Jumps (Strides)				
Training Session				
Joint / Range of Movement (ROM) of Exercises			**Aerobic, Strength and Core Functional Training**	
Description	Neck Shoulder Elbow Wrist Spine Hips Knee Ankle	Flexion Rotation Abduction Adduction Internal / external rotation Dorsiflexion Palmar / Plantar flexion	Upper Limbs	Pushing / Pulling Exercises
			Core	Core Stability Isometrics
			Lower Limbs	Knee / Hip Dominant Exercises
			Aerobic Training	Aquatic Walking / jogging Aerobics
Progression	Type: multi-joint / single-joint resistance exercises Repetitions: 10-15 to 20-25			

Series: 1 to 4-5 Isometric work: 10”-30” Intensity: 4-7 (RPE) Rest: 1’-1’30” Session Duration: 35-50 min Frequency: 2-3 sessions per week Program Duration: 17 sessions / 6 weeks
Cool-down Flexibility Training Hydromassage and relaxation

ROM: Range of motion exercise; RPE: Rated Perceived Exertion. The progression is established prior the session based on the sensations and specific daily state of the patient.

On the other hand, and following the recommendations of previous research, the room temperature of the spa facility used was 32ºC, the pool water was over 33ºC and it had a depth of 0.9 meters in the strength and flexibility training zone and 1.25 meters in the endurance training area. 32-33 degrees is the lowest range of recommended temperature for improvement of the fibromyalgia symptomatology (Bidonde et al., 2014). Investigating the results of training in these types of spa pools can be helpful to reduce and eliminate barriers to practice exercise due to the lack of adequate facilities.

It is important to highlight that, unlike other previous programs, the whole aquatic fitness session (warm-up, fitness program and cool down), were fully carried out in an aquatic environment into a spa pool. Strength, core and flexibility were training every day, from the beginning of the program, while aerobic endurance program was included from the second week with a frequency of 2 sessions. Resistance training was based on the work of functional movement patterns, and it was divided into multi- and single-joint functional exercises of pushing and pulling movements for the upper limbs, and knee dominant or hip dominant movement for the lower limbs (Boyle, 2017). The core strengthening training consisted in isometric stabilization exercises carried out submerged into the spa pool. As its stabilizing function, the core was trained through anti-rotation, anti-lateral flexion, and anti-extension isometric exercises. To regulate the intensity of the core exercises, the specialist applied a manual counter-resistance to the participant on the scapula (anti rotation), on the upper back (anti-extension) and on the shoulder (anti-lateral flexion), thus having to use the core as a stabilizer to resist external forces and disturbances. A stimulation of a maximum of 10 seconds has been used, following the recommendations of previous research (McGill, 2003). All of the exercises were performed with the help of aquatic materials, with a progression towards unilateral movements and with increased movement velocity. The intensity of the sessions was controlled by the OMNI-RES 0-10 scale of rated perceived exertion (RPE) (Robertson et al., 2003). Regarding the flexibility training, performed exclusively with submerged working joints, it was based on slow joint mobility work throughout each articular range of movement (ROM), with a maximum stimulus of 30 seconds and avoiding potentially harmful movements. Finally, for performing the aerobic training, activities such as aquatic walking and / or jogging were carried out in the 1.25-meter-deep pool, with a maximum duration of 20 minutes of overall session.

Throughout the aquatic fitness program, the patient symptomatology was varying. Although the symptoms gradually and progressively improved the different physical and psychological factors, the feeling of fatigue and pain reported by participant in some days made it necessary to adapt the session or reduce the training load and volume previously programmed for this session. For this purpose, the RPE scale as well as the direct interview and feedback from the patient were used to find out whether the patient had pain previously and/or during the training session.

Data Collection and Analysis

The data collection for all the physical and psychological tests was performed by two researchers, just prior and after the intervention period. Fitness-related components (strength, balance, agility and aerobic) were evaluated through the use of specific instruments commented in Table 1. Likewise, different psychological parameters, as subjective perception of health and fatigue, pain index, quality of sleep, depression, interference of symptoms of activities of daily living, were evaluated using the specific validated questionnaires described on Table 2. Once all the pre- and post-intervention data were collected, they were extracted in a spreadsheet, and subsequently analyzed and compared. After making a comparison among them and to know the effects of the aquatic training performed for the 6-week intervention, it was stablished the improvement percentages (%) as differences in the results of the pre- and post-intervention tests and questionnaires.

Results

Follow-up results and Outcomes

In this case report, participated a 62-year-old woman with a height of 155 cm and 82.5 kg of body mass. Baseline data indicated a correct static balance (maximum score) but low degree of lower body strength, aerobic capacity, and left-hand manual strength. However, after the aquatic training intervention, results of improvement were obtained in all parameters evaluated, maintaining the static balance at the maximum score. Specifically, the obtained data in the force parameter showed an increase for both grip strength of 14.86% (right hand), 3.56%

(left hand) and in the lower limb an increase of 27.27% (30s-CST), being the percentage for cardiorespiratory capacity in a minor improvement degree (10.59%). On the other hand, and even though no variations were obtained in the static balance, an increase in dynamic balance or agility of 11.94% was observed.

Regarding the psychological data, the pre-intervention results indicated a good subjective perception of health (SF-36) and the absence of depressive states (BDI). On the other hand, although at the beginning of the program the patient had difficulty falling asleep, a mean levels of pain severity and pain interference in general in activities of daily living, after the training program a positive progression was observed in all these psychological parameters. Finally, fatigue (measured through MFI-20) was reduced with an improvement in the 4 items related to general fatigue, in 3 of the items of physical fatigue, in 2 of activity reduction, in 2 of motivation reduction and in 1 of mental fatigue. Table 4 shows the results in each of the tests in both evaluations as well as the improvement percentages, and minimal detectable change (MDC) and minimum clinically important difference (MCID) standard values.

Table 4. Pre- and post- intervention results, differences, and percentages of improvement and MDC / MCID values for the different factors analyzed.

Test or questionnaire	Pre	Post	% Improvement	Difference	MDC	MCID
HG_right (kg)	29.6	34	14.86%	**4.40***	4.04	---
HG_left (kg)	28.1	29.1	3.56%	1.00	4.04	---
30s_CST (repetitions)	11	14	27.27%	**3***	2.52	---
Static Balance (scores)	4	4	0%	0	---	---
TUG (seconds)	8.29	7.30	11.94%	-0.99	-1.60	---
6MWT (meters)	456.83	505.20	10.59%	48.37	65.20	---
SF-36	63.4	74.05	16.72%	**10.65***	---	5
Pain severity (BPI_s)	5.5	4.25	22.73%	-1.23	---	-2.16 (34.2) †
Pain interference (BPI_i)	4.14	2	51.69%	**-2.14***	---	-2.09 (32.3) †
VAS	37.5	15	60%	**-22,5***	-8	---
PSQI	9	6	33.33%	-3	---	---
BDI	15	5	66.67%	**-10***	-8,7	---
FIQR	55.7	39	29.98%	**-16,7***	---	-14

HG: hand grip strength; 30s_CST: 30 seconds chair stand test; TUG: Time up and go test; 6 MWT: 6 meters walking tets; VAS: Visual Analogue Scale: PSQI: Pittsburgh Sleep Quality Index; BDI: Beck's Depression Inventory; FIQR: Revised Fibromyalgia Impact Questionnaire. MDC: Minimal Detectable Change (Alghadir et al., 2018; Carlos-Vivas et al., 2020; Huang et al., 2017). MCID: minimum clinically important difference *Differences over the MDC and MCID established standard values; † Expressed as score reduction (PGI-I improved PGI-I stable) and percent reduction from baseline (Bennett et al., 2009; Busija et al., 2008; Mease et al., 2011).

Discussion

The present study aimed to test the feasibility and suitability of a fully aquatic functional fitness program, based on a multicomponent approach (strength, core, aerobic and flexibility training), and developed in a spa pool, as an alternative to conventional land-based training, for a fibromyalgia woman with previously proved low tolerance and adherence to physical exercise. Furthermore, a complete analysis for this patient of most common physical and psychological parameters related to symptoms of this disease is provided before and after training program. The results after training showed an enhancement in all the physical and phycological parameters analyzed. However, on some occasions they remained below for the reference values for a healthy population (Rikli & Jones, 2013) of the same age, possibly due to the short duration of the program. With respect to the MDC and MCID reference values, it can be observed that the pre-post difference of our results for the HG_right, 30s_CST, SF_36, BPI_i, VAS, BDI and FIQR, are over those considered clinically significant for this population, or at least over the measurement error of these assessments. Other results are, however, somewhat below these MDC and MCID reference values, possibly due to the short term of intervention. In general terms, it seems that these results support the idea that this type of aquatic program may be a good physical training approach for this patient who previously showed a profile of low adherence and tolerance to conventional land-based training, but with good acceptance towards aquatic activities.

Firstly, the patient was able to complete 6 weeks of training, showing good levels of progression, tolerance, and adherence to the aquatic program. Moreover, the results in all physical tests after training were better than initial tests. In this line, previous studies with fibromyalgia patients have similarly reported improvements in different physical variables such as grip strength, lower body strength or cardiovascular capacity, in people with fibromyalgia after water a training intervention (Bidonde et al., 2014; Sevimli et al., 2015). In fact, a previous study made a comparison between two training protocols (terrestrial vs aquatic

programs) obtaining more significant improvements in the cardiorespiratory capacity after the aquatic training intervention (Sevimli et al., 2015).

Secondly, from the results obtained in the physical tests, the improvements in the psychological parameters were expected, based on the relationship between the physical and mental health, as well as based on the reduction in the risk of suffering musculoskeletal damage, sleep disturbances and difficulties during daily living activities (Andrade et al., 2017; Häuser et al., 2010; Kelley et al., 2010). In fact, previous studies have already demonstrated how, through an adequate physical training program, the improvement in all these psychological variables can be achieved in fibromyalgia patients (Andrade et al., 2018; Ericsson et al., 2016; Palstam et al., 2016; Segura-Jiménez et al., 2013). Accordingly, one previous investigation, after an 18-week physical training program, showed improvements in perceived pain, balance and ability to produce force (Latorre Roman et al., 2015). Other study obtained improvements in the MFI-20, specifically in reduced motivation and mental fatigue after a program of physical exercise in an active environment combined with educational activities (Mannerkorpi et al., 2000). While most programs focused on a specific type of effort (only an aerobic or strength training), several studies applied multicomponent training programs composed of endurance training, resistance training and relaxation (Munguía-Izquierdo & Legaz-Arrese, 2007). In this line, and considering the best scores achieved in the physical variables analyzed in the present case report, we observed how our patient's pain was reduced, thereby improving her quality of sleep, the influence of the disease on activities of her daily living and in general her subjective perception of physical and mental health. For this purpose, we think that it would be recommended to use spa or indoor pools with constant high temperatures between 32 and 33 degrees Celsius. Future studies with more sample size will be needed to support this recommendation.

In summary, the results of this case report, supported by previous studies, showed that an aquatic functional and multicomponent intervention in a spa pool can be a good training approach for our fibromyalgia patient who previously showed intolerance or lack of adherence to land-based training or aquatic training in a conventional pool. In addition, the improvement of all physical and psychological symptoms evaluated in our patient indicates the feasibility of this training approach to be used in future experimental designs based on this type of training. Despite this, more studies with more sample size are required to investigate the progression of the disease, the relationship between the influencing variables, the type of most effective physical interventions, as well as the implementation of programs with continuity and long-term follow-up that avoid the reversal of the improvements achieved with this type of training in fibromyalgia patients (Andrade et al., 2019).

Limitations

This study is only a case report. Therefore, the results should be interpreted with caution, as only one patient is analyzed and there are not enough reference values available for the exact comparison of the results as minimal detectable changes or minimum clinically important difference. It would be necessary to apply the same training protocol in a representative sample of the population and having a control group to determine the effects of training in a meaningful way. In addition, the validation of specific physical tests in people with fibromyalgia is required as future research lines to allow an accurate comparison of the results.

Conclusions

This study assessed the feasibility of an aquatic multicomponent fitness program developed in a spa pool as a complement for the treatment of a woman with fibromyalgia. In general terms, the results showed an enhancement in all the physical and phycological parameters analyzed. Compared to MDC and MCID reference values, it was observed that the measures for the hand grip strength, the lower limb strength, the subjective perception of health, Depression, the severity and the interference of pain, and the impact of fibromyalgia in DLA, improved above the values considered clinically significant for this population, or at least over the measurement error of these assessments. However, the other results were below these MDC and MCID reference values, possibly due to the short term of intervention.

The results of this case report support the effectiveness and feasibility of a fully multicomponent aquatic training as an optimal non-pharmacological approach to improve physical and psychological symptoms in this fibromyalgia patient with low tolerance and adherence to the conventional physical practice. In addition, the complete physical and psychological analysis provided in this study offers relevant and referential information for future studies investigating about aquatic fitness programs targeting fibromyalgia patients.

Conflicts of interest - The authors declare no conflict of interest.

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